

REMARKS

Favorable consideration and allowance of claims 1-4 are requested in view of the foregoing amendments and the following remarks.

Claims 1-4 were rejected under 35 U.S.C. § 103 as being unpatentable over Ishii et al. (US 2002/0038692) in view of Suzuki et al. (US 6,652,709). Applicants respectfully traverse the rejection as set forth below.

As a preliminary matter, Applicants note that Mr. Nobuo Ishii, an inventor of the present invention, is one of the two inventors of the Ishii et al. reference cited in the Office Action. The present invention provides further improvement on the plasma processing apparatus disclosed in the Ishii et al. reference, and particularly discloses a structure for more strongly coupling the first standing wave formed in the radial waveguide and the second standing wave formed in the portion containing the top plate portion and the antenna portion.

In a plasma processing apparatus, the plasma production region within a chamber is maintained by the mutual coupling of the first and second standing waves. If the mutual coupling thereof is weak, there is a tendency that the second standing wave predominantly contributes to maintenance of the plasma production region. However, the second standing wave is liable to vary depending on a process condition such as a pressure in the chamber, and if the second standing wave varies, it becomes difficult to control the electromagnetic

field, which forms the plasma production region. This causes a problem of variations in etching rate or film deposition rate (see the "Background Art" section of the specification).

To overcome such a problem, the invention according to claim 1 in the present application is directed to a structure that satisfies the formula $((B - A)/2 = (\lambda_g/2) \cdot N)$ recited in claim 1, so as to couple the first and second standing wave more strongly. In the formula, A is the inner diameter of the radial waveguide, B is the inner diameter of the antenna portion, λ_g is wavelength of the high-frequency electromagnetic field and N is zero or a natural number. As described below, this formula cannot be conceived from the Suzuki et al. reference, which discloses a plasma processing apparatus that forms standing waves in a circumferential direction.

Initially, the Office Action asserts that the Ishii et al. reference discloses the features of claim 1, except for relative dimensions of the inner diameter A of the radial waveguide and the inner diameter B of the portion containing the top plate portion of the antenna portion. Further, the Office Action asserts that the Suzuki et al. reference discloses a specific dimensional relationship between the dielectric window (top plate portion) 4 and the microwave applicator (circular waveguide) 3, contending that one skilled in the art would have conceived the present invention by applying the dimensional relationship to the Ishii et al. reference.

In the plasma processing apparatus disclosed in the Ishii et al. reference, the electromagnetic fields that have propagated in the radial waveguide 36 propagate in the antenna portion in a radial direction to form standing waves of a high-frequency electromagnetic field in a region S1 containing the antenna portion and the top plate portion arranged with a space therebetween (see paragraph [0098] in the specification). Accordingly, in the plasma processing apparatus in the Ishii et al. reference, standing waves of the high-frequency electromagnetic field are formed in a radial direction.

By contrast, in the plasma processing apparatus of the Suzuki et al. reference, there is provided a microwave applicator 3 for introducing microwaves into the plasma generation chamber 9 (see Figs. 6A-6B and lines 32-51 of column 11 in the specification). The microwaves that have propagated in the junction circuit (waveguide) 15 propagate in the microwave applicator 3 in a circumferential direction (see Figs. 5A and lines 1-42 of column 7 in the specification). Accordingly, in this plasma processing apparatus, standing waves are formed in a circumferential direction of the microwave applicator 3. In other words, the manner by which standing waves of the high-frequency electromagnetic field are generated in Suzuki et al. is completely different from Ishii et al.

Furthermore, in the plasma processing apparatus in the Suzuki et al. reference, the dielectric window 4 is arranged immediately below the microwave

applicator 3, and microwaves in the circular waveguide are directly introduced from a slot 23 into the chamber through the dielectric window 4. In this plasma processing apparatus, no space is provided between the microwave applicator 3 and the dielectric window 4, and hence there is no disclosure or suggestion of forming standing waves of microwaves in such a region.

In view of the foregoing, there is no teaching, suggestion or motivation for associating the dimensional relationship of the structure where standing waves are formed in such a circumferential direction with the dimensional relationship of the structure where standing waves are formed in a radial direction.

Furthermore, it cannot be conceived to allow the Ishii et al. reference, which has regions where the first and second standing waves are formed, respectively, to satisfy the formula recited in claim 1, based on the dimensional relationship in the Suzuki et al. reference. The dielectric window 4 of Suzuki et al. is arranged immediately below the microwave applicator 3, and thus the structure of Suzuki et al. fails to have a region corresponding to the region as described in the Ishii et al. reference where the second standing wave is formed. Accordingly, Suzuki's structure is not designed to form standing waves in such a region.

In view of the foregoing, even if the teachings of the Suzuki et al. reference were combined with the teachings of the Ishii et al. reference, the structure satisfying the formula recited in claim 1 would not be achieved. Therefore, claim

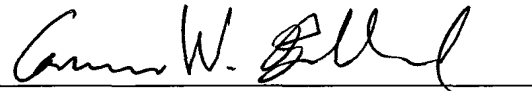
1 and its dependent claims 2-4 are patentable over the combination of Ishii et al. and Suzuki et al.

If there are any questions regarding this amendment or the application in general, a telephone call to the undersigned would be appreciated since this should expedite the prosecution of the application for all concerned.

If necessary to effect a timely response, this paper should be considered as a petition for an Extension of Time sufficient to effect a timely response, and please charge any deficiency in fees or credit any overpayments to Deposit Account No. 05-1323 (Docket #101248.55500US).

Respectfully submitted,

June 6, 2007



Jeffrey D. Sanok
Registration No. 32,169
Cameron W. Beddard
Registration No. 46,545

CROWELL & MORING LLP
Intellectual Property Group
P.O. Box 14300
Washington, DC 20044-4300
Telephone No.: (202) 624-2500
Facsimile No.: (202) 628-8844
JDS:CWB:crr
3298173